IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re the Appellant:	Appeal No.:
KIRIMURA et al.	Art Unit: 1765
Application No.: 09/822,414	Examiner: M. Song
Filed: April 2, 2001	Attorney Dkt. No.: 107351-00011

For: FILM FORMING APPARATUS AND METHOD OF FORMING A CRYSTALLINE SILICON FILM

BRIEF ON APPEAL

Date: September 26, 2003

I. INTRODUCTION

This is an appeal from the February 26, 2003, Office Action finally rejecting claims 16-32, all of the claims pending in this application, as being unpatentable over certain prior art under 35 U.S.C. 103. An Amendment After Final Rejection was filed on May 27, 2003, within the shortened statutory period to respond. An Advisory Action mailed June 3, 2003, was received which made no indication regarding whether the proposed amendments in the May 27, 2003, Amendment After Final Rejection will be entered. The Advisory Action states that the request for reconsideration has been considered but does not place the application in condition for allowance. A Notice of Appeal was timely filed on July 28, 2003, with a Petition for Extension of Time. This Brief is being timely filed.

II. REAL PARTY IN INTEREST

The real party in interest in present application on appeal is Nissin Electric Co., Ltd., by way of an assignment recorded in the United States Patent and Trademark Office at Reel 9869, Frame 0734.

III. RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences known to the appellant, appellant's representative or assignee which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

IV. STATUS OF CLAIMS

Claims 16-32, all of the claims pending in the present application are being appealed. Claim 16 is independent and claims 17-32 are dependent therefrom. The amendments to claim 30 submitted in the Amendment After Final Rejection filed May 27, 2003, are not acknowledged as being entered or as not being entered by the Examiner for the purposes of appeal.

V. STATUS OF AMENDMENTS

An Amendment After Final Rejection was timely filed on May 27, 2003. No indication has been provided as to whether the amendments therein would be entered upon the filing of an appeal by the Advisory Action dated June 3, 2003.

VI. SUMMARY OF THE INVENTION

The present invention relates to a method for forming a crystalline silicon film. As disclosed in the present specification, "[a]ccording to the invention, the formation of [a] pre-film of [a] crystalline silicon film and [a] subsequent irradiation of the pre-film with [an] energy beam can be continuously performed in the same vacuum chamber.

Therefore, the time required for transporting the substrate as well as the time required for heating the substrate can be significantly reduced so that the throughput can be improved. Further, since the formation of the pre-film and the irradiation with the energy beam can be performed in the same vacuum chamber, it is possible to produce the crystalline film having a good quality while suppressing adhesion of [impurities]" (see page 7, lines 5-15, of the present specification).

VII. THE FINAL REJECTION

Claims 16-32 are pending in this application. No claim stands allowed.

Claims 16, 18 and 31-32 were finally rejected under 35 U.S.C. § 103(a) as being unpatentable over Zhang et al. (U.S. Patent No. 5,578,520) in view of Schachameyer et al. (U.S. Patent No. 4,685,976). Claims 17 and 19-30 were finally rejected under 35 U.S.C. § 103(a) as being unpatentable over Zhang et al. in view of Schachameyer et al. and further in view of one or more of Fan et al. (U.S. Patent No. 4,309,225), Asakawa et al. (U.S. Patent No. 5,795,385), Selvakumar et al. (U.S. Patent No. 5,633,194), Ichikawa et al. (U.S. Patent No. 5,484,746) and Krimmel (U.S. Patent No. 4,140,546)

VIII. ISSUES ON APPEAL

The first issue on appeal is whether claims 16, 18 and 31-32 would have been obvious over Zhang et al. (U.S. Patent No. 5,578,520) in view of Schachameyer et al. (U.S. Patent No. 4,685,976). The second issue is whether claims 17 and 19-30 would have been obvious over Zhang et al. in view of Schachameyer et al. and further in view of one or more of Fan et al. (U.S. Patent No. 4,309,225), Asakawa et al. (U.S. Patent No. 5,795,385), Selvakumar et al. (U.S. Patent No. 5,633,194), Ichikawa et al. (U.S. Patent No. 5,484,746) and Krimmel (U.S. Patent No. 4,140,546).

IX. GROUPING OF CLAIMS

Each claim of this patent application is separately patentable, and upon issuance of a patent will be entitled to a separate presumption of validity under 35 U.S.C. 282. For convenience in handling of this appeal, all of the claims being rejected stand together.

X. APPELLANT'S ARGUMENTS

Legal Overview

In the February 26, 2003 Office Action, Claims 16, 18 and 31-32 were finally rejected under 35 U.S.C. § 103(a) as being unpatentable over Zhang et al. (U.S. Patent No. 5,578,520) in view of Schachameyer et al. (U.S. Patent No. 4,685,976). Claims 17 and 19-30 were finally rejected under 35 U.S.C. § 103(a) as being unpatentable over Zhang et al. in view of Schachameyer et al. and further in view of one or more of Fan et al. (U.S. Patent No. 4,309,225), Asakawa et al. (U.S. Patent No. 5,795,385), Selvakumar et al. (U.S. Patent No. 5,633,194), Ichikawa et al. (U.S. Patent No. 5,484,746) and Krimmel (U.S. Patent No. 4,140,546).

Several basic factual inquiries must be made to determine obviousness or non-obviousness of patent application claims under 35 U.S.C. § 103. These factual inquiries are set forth in Graham v. John Deere Co., 383 U.S. 1, 17, 148 U.S.P.Q. 459, 467 (1996):

> Under § 103, the scope and content of the prior art are to be determined; differences between the prior art and the claims at issue are to be ascertained; the level of ordinary skill in the pertinent art resolved. Against this backdrop, the obviousness or non-obviousness of the subject matter is determined.

The specific factual inquiries set forth in *Graham* have not been considered or properly applied by the Examiner formulating the rejections of the claims. Particularly the differences between the prior art and the claims were not properly determined. As stated by the Federal Circuit in In re Ochiai, 37 U.S.P.Q. 2d 1127, 1131 (Fed. Cir. 1995):

> [t]he test of obviousness *vel non* is statutory. It requires that one compare the claim's subject matter as a whole with a prior art to which the subject matter pertains. 35 U.S.C. § 103.
>
> The inquiry is highly fact-specific by design.... When the references cited by the Examiner fail to establish a *prima facie* case of obviousness, the rejection is improper and will be overturned. In re Fine, 837 F.2d 1071, 1074, 5 U.S.P.Q. 2d 1596, 1598 (Fed. Cir. 1988). (Emphasis added.)

When rejecting claims under 35 U.S.C. § 103, an Examiner bears an initial burden of presenting a prima facie case of obviousness. A prima facie case of obviousness is established only if the teachings of the prior art would have suggested the claimed subject matter to a person of ordinary skill in the art. If an Examiner fails to establish a prima facie case, the rejection is improper and will be overturned. See: In re Rijckaert, 9 F.3d 1531, 28 U.S.P.Q. 2d. 1955 (Fed. Cir. 1993). "If examination.... does not produce a prima facie case of unpatentability, then without more the applicant is entitled to the grant of the patent." In re Oetiker, 977 F.2d 1443, 1445 - 1446 24 U.S.P.Q. 2d. 1443, 1444 (Fed. Cir. 1992).

Appellants respectfully submit that the Examiner has not made a proper *prima facie* rejection under 35 U.S.C. § 103(a), because the combination of prior art

references cited fails to teach or suggest the present invention and because it would not have been obvious to combine the cited references.

The presently claimed invention is directed to a crystalline silicon film forming method including preparing a film forming apparatus having a silicon film forming vacuum chamber for forming a crystalline silicon film on a substrate, and provided with a film forming device for forming a pre-film of the crystalline silicon film on the target surface of the substrate, and an energy beam radiating device for irradiating said pre-film with an energy beam for crystallizing the pre-film. In the presently claimed invention, both the forming of the pre-film of the crystalline silicon film on the target surface as well as the irradiation of the pre-film is conducted in the vacuum chamber.

Thus, in the presently claimed method, in a single vacuum chamber, a crystalline silicon pre-film is formed on a target surface and subsequently the pre-film is irradiated with an energy beam for crystallization on the pre-film.

Zhang et al. disclose a method for annealing a semiconductor. Zhang et al. teach against conducting both forming a pre-film and irradiation of the pre-film in a single chamber. In particular, Zhang et al. disclose "[a] method for manufacturing a semiconductor device including preparing a multi-chamber system having **at least** first and second chambers, the first chamber for forming a film and the second chamber for processing an object with a laser light..." (see the Abstract of Zhang et al., emphases added).

Thus, in view of the Zhang et al. teaching against using less than first and second chambers to conduct forming a film and irradiation, Applicants respectfully

submit that one of skill in the art would not have been motivated to conduct both forming a pre-film and irradiation of the pre-film in a single chamber.

Schachameyer et al. has been cited to show a single chamber semiconductor processing chamber. The February 26, 2003, Office Action asserted that Schachameyer et al. teaches that radiation is introduced into the chamber to react with a gas to epitaxially deposit a first layer.

However, it is respectfully noted that in Schachameyer et al., "excimer laser radiation is introduced into the chamber at a first discrete wavelength to photolytically react with a [gas] ... at a discrete excitation energy photochemically breaking bonds of the [gas] to epitaxially deposit a first layer on substrate 4, without thermally driven pyrolytic deposition ..." (see Schachamayer et al., column 1, lines 64, to column 2, line 2).

The laser of Schachameyer et al. is for a photo-CVD method and is used to decompose a gas. On the other hand, the laser of the present invention is for annealing a formed film, which is completely different in purpose and function from the laser of Schachameyer et al.

Applicants respectfully submit that Schachameyer et al. nowhere teaches or suggests forming any pre-film prior to any crystallizing irradiation step nor does Schachameyer et al. anywhere provide any way to form a pre-film on a substrate prior to any crystallizing irradiation step. Thus, Schachameyer et al. do not teach, suggest or enable "irradiating [a] pre-film" as is required by the present claims.

Applicants further respectfully submit that one of skill in the art would not have been motivated to modify the pre-film forming method taught by Zhang et al. with the

Schachameyer et al. no-pre-film forming single chamber. Additionally (and alternatively), Applicants respectfully submit that one of skill in the art would not have been motivated to modify the Schachameyer et al. no-pre-film forming single chamber with the pre-firm forming method taught by Zhang et al.

Furthermore, Applicants respectfully submit that it would destroy the Schachameyer et al. principle of operation to not use an excimer laser to modify a gas to deposit a layer on a substrate, but to instead deposit a layer on a substrate and then to subsequently use a laser to crystallize the deposited pre-film. Similarly, Applicants respectfully submit that it would destroy the Zhang et al. principle of operation to not deposit a layer on a substrate and then subsequently use a laser to crystallize the deposited pre-film, but to instead use an excimer laser to modify a gas to deposit a layer on a substrate.

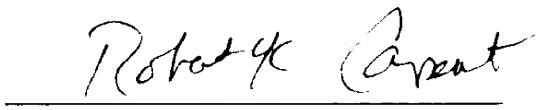
As none of Fan et al., Asakawa et al., Selvakumar et al., Ichikawa et al. and/or Krimmel make up for the above-discussed deficiencies in Schachamyer et al. and Zhang et al., Applicants respectfully submit that the presently claimed invention would not have been obvious over any combinations of the applied references.

For all of the above noted reasons, it is strongly contended that certain clear differences exist between the present invention as claimed in claims 16-32 and the prior art relied upon by the Examiner. It is further contended that these differences are more than sufficient that the present invention would not have been obvious to a person having ordinary skill in the art at the time the invention was made.

This final rejection being in error, therefore, it is respectfully requested that this honorable Board of Patent Appeals and Interferences reverse the Examiner's decision in this case and indicate the allowability of application claims 16-32.

In the event that this paper is not being timely filed, Applicants respectfully petition for an appropriate extension of time. Any fees for such an extension together with any additional fees which may be due with respect to this paper may be charged to our Deposit Account No. 01-2300 referring to Attorney Docket No. 107351-00011.

Respectfully submitted,



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APPENDIX 1

CLAIMS ON APPEAL

16. A crystalline silicon film forming method comprising the steps of:

preparing a film forming apparatus having a single silicon film forming vacuum chamber for forming a crystalline silicon film on a substrate, and provided with a film forming device for forming a pre-film of the crystalline silicon film on a target surface of said substrate, and an energy beam irradiating device for irradiating said pre-film with an energy beam for crystallizing said pre-film;

locating the substrate in said silicon film forming vacuum chamber, and forming the pre-film of the crystalline silicon film on the target surface of said substrate by said film forming device; and

producing the intended crystalline silicon film from said pre-film by irradiating said pre-film in said vacuum chamber with said energy beam for crystallization of said pre-film emitted from said energy beam irradiating device subsequently to the formation of said pre-film.

17. The crystalline silicon film forming method according to claim 16, wherein

said film forming device employs such a structure that can form said pre-film over a length, in a first direction, of the target surface of said substrate, said energy beam irradiation device employs such a structure that can irradiate the target surface of said substrate over the length in the first direction with the energy beam, and the intended crystalline silicon film can be successively formed by operating said film forming device to form said pre-film on the target surface of said substrate, and concurrently operating

said energy beam irradiation device to irradiate the formed pre-film with the energy beam while moving said substrate in a second direction crossing said first direction.

18. The crystalline silicon film forming method according to claim 16, wherein said silicon film forming vacuum chamber is further provided with an ion source, and said pre-film of the crystalline silicon film is formed on said target surface while emitting an ion beam to the target surface of said substrate in said step of forming said pre-film by said film forming device.

19. The crystalline silicon film forming method according to claim 17, wherein said silicon film forming vacuum chamber is further provided with an ion source, and said pre-film of the crystalline silicon film is formed on said target surface while emitting an ion beam to the target surface of said substrate in said step of forming said pre-film by said film forming device.

20. The crystalline silicon film forming method according to claim 16, wherein said silicon film forming vacuum chamber is further provided with an ion source, an ion beam is emitted to the target surface of said substrate from said ion source prior to said step of forming said pre-film by said film forming device, and said pre-film is formed on said target surface irradiated with the ion beam.

21. The crystalline silicon film forming method according to claim 17, wherein

said silicon film forming vacuum chamber is further provided with an ion source, an ion beam is emitted to the target surface of said substrate from said ion source prior to said step of forming said pre-film by said film forming device, and said pre-film is formed on said target surface irradiated with the ion beam.

22. The crystalline silicon film forming method according to claim 16, wherein said silicon film forming vacuum chamber is further provided with an ion source, and an ion beam is emitted to the target surface of said substrate from said ion source in an initial stage of said step of forming said pre-film by said film forming device.

23. The crystalline silicon film forming method according to claim 17, wherein said silicon film forming vacuum chamber is further provided with an ion source, and an ion beam is emitted to the target surface of said substrate from said ion source in an initial stage of said step of forming said pre-film by said film forming device.

24. The crystalline silicon film forming method according to claim 16, wherein said silicon film forming vacuum chamber is further provided with an ion source, and an ion beam is emitted to the target surface of said substrate from said ion source during a period from a stage before said pre-film forming step of forming said pre-film by said film forming device to an initial stage of said pre-film forming step.

25. The crystalline silicon film forming method according to claim 17, wherein

said silicon film forming vacuum chamber is further provided with an ion source, and an ion beam is emitted to the target surface of said substrate from said ion source during a period from a stage before said pre-film forming step of forming said pre-film by said film forming device to an initial stage of said pre-film forming step.

26. The crystalline silicon film forming method according to claim 18, wherein an emission energy of said ion beam is in a range from 100 eV to 1 keV.

27. The crystralline silicon film forming method according to claim 20, wherein an emission energy of said ion beam is in a range from 500 eV to 10 keV.

28. The crystalline silicon film forming method according to claim 22, wherein an emission energy of said ion beam is in a range from 500 eV to 10 keV.

29. The crystalline silicon film forming method according to claim 22, wherein an emission energy of said ion beam is in a range from 2 keV to 10 keV.

30. The crystalline silicon film forming method according to claim 25, wherein an emission energy of said ion beam is in a range from 500keV to 500eV.

31. The crystalline silicon film forming method according to claim 18, wherein said film forming device employs a structure performing the film formation by plasma CVD.

32. The crystalline silicon film forming method according to claim 31, wherein the formation of the pre-film by said plasma CVD uses a mixture gas of a silicon-contained gas and a hydrogen gas as a gas for film formation.

APPENDIX II

DRAWINGS OF APPLICATION SERIAL NO. 09/822,414